



SA YEARBOOK 2007/08 | SCIENCE AND TECHNOLOGY



The Department of Science and Technology seeks to realise the full potential of science and technology (S&T) in social and economic development, through the development of human resources, research and innovation.

The department primarily focuses on implementing the National Research and Development Strategy (NRDS), which provides for an integrated approach to HR development, knowledge generation, investment in infrastructure and improving the strategic management of the public S&T system.

The revised strategic-management model for the S&T system enables the department to develop emerging and rapidly changing areas of S&T, and to co-ordinate and support sector-specific S&T activities initiated by other government departments.

Expenditure is expected to continue to increase rapidly, rising from R1,4 billion in 2003/04 to an expected R4,1 billion in 2009/10; representing an average annual increase of 20%. Most of this expenditure comprises transfers to public entities for S&T initiatives.

South Africa has to address what the NRDS identifies as the "innovation chasm"; the gap that exists between the knowledge generators and the market. One of the things the department is proposing to narrow or close this innovation gap, is the establishment of an institution to be called the Foundation for Technological Innovation (FTI).

The FTI will have the competency to assist the National System of Innovation (NSI) to mine the existing body of knowledge, and to develop technology-based services and products that could be commercialised and diffused through the economy.

Legislation

Government plays a formative role in research and innovation by developing and approving policy, legislation and regulatory frameworks; setting the overall national agenda; and creating an enabling environment for research and innovation to thrive. Since 1994, government has put forward a range of mechanisms to encourage innovation in the private sector, government research institutes and the Higher Education (HE) sector.

The Joint Initiative for Priority Skills Acquisition (Jipsa) and the sector education and training authorities are other strategies and tactics used to address shortages of various skills. In particular Jipsa, as a framework, is aimed at addressing the shortage of urgently needed skills. It targets and

mobilises unemployed graduates, and retired and foreign experts for deployment into the economy. Through this process, knowledge is shared and transferred.

The department is determined to realise its mission to develop, co-ordinate and manage an NSI that will help achieve a critical mass of the required human capital, realise sustainable economic growth and improve the general quality of life of the people of South Africa, including its regional neighbours and the continent of Africa.

As part of developing the NSI, all programmes and initiatives are carried out in partnership with business, labour, academia, research councils, HE institutions and other knowledge producers.

National System of Innovation

The *White Paper on S&T, 1996* introduced the NSI as the basis of the S&T interventions in the South African economy.

Aligned with South Africa's national developmental priorities and programmes, such as, among other things, the Accelerated and Shared Growth Initiative for South Africa (AsgiSA) and the National Spatial Development Programme, substantial progress has already been made in this regard.

Government has set the target of spending a minimum of 1% of gross domestic product (GDP) of public and private expenditure on research and development (R&D) by 2008.

The department's ongoing efforts towards achieving further economic growth, by stimulating R&D in the private sector, have been given added impetus with the Minister of Finance's announcement of the 150% tax credit for R&D in February 2006.

This new tax incentive means that, with a corporate tax rate of 36%, government will forego 18 cents of tax revenue for each rand spent on R&D.

Given that private-sector expenditure on R&D amounted to about 0,45% of GDP by May 2007, this tax credit could translate to a further R1 billion allocated to R&D.

By 2001/02, international funding on R&D in South Africa had grown to 6%, from close to zero in 1994. By 2003/04, foreign funding stood at 10% of total R&D funding. A 2005/06 survey indicated that in 2003/04, businesses, universities, science

councils, government research institutes and non-governmental organisations (NGOs) spent R12 billion on R&D, equivalent to 0,87% of GDP.

Surveys indicate that government has increased national spending on R&D by about R4,5 billion over the past five years. As the custodians of the NSI, the Department of Science and Technology recognises that investment decisions can be enhanced with a strong information base on research activities funded by public funds.

For these purposes, the department is setting up the Research Information Management System to gather and make available information on research activities within science councils and other government research agencies. This will strengthen its capacity to monitor the performance of the S&T system and provide a rigorous long-term planning platform for the NSI.

The Department of Science and Technology is also providing resources and is co-operating with universities and the National Research Foundation (NRF) to use a licensed information technology (IT) platform to gather and make available information on research activity within tertiary education institutions.

The largest share of the department's budget over the medium term, about R323 million, goes to the Human Capital Development Programme, which addresses the adequate development and renewal of human scientific resources. It will strengthen current programmes, which include the:

- Research Professional Development Programme, which targets young Science,



Early in 2007, the Human Sciences Research Council released the results of the first official *South African Innovation Survey*. It is modelled on the survey used in all European Union countries in 2005/06, showing that more than half of South Africa's companies engaged in the development of new products and processes between 2002 and 2004.

South Africa's rate of innovation is well above that of the European average of 42% for 2004.

According to the survey, South African companies spent about R27,8 billion on innovative activities in 2004, representing about 2,4% of the total turnover of all business in the industrial and service sectors.

While the bulk of this expenditure was devoted to the acquisition of new machinery, equipment and software, in-house research and development expenditure accounted for some 20% of total innovation expenditure.

Ten percent of successful innovators in industry received public funding for innovation activities.

Engineering and Technology (SET) masters and doctoral students

- Postdoctoral Fellowship Programme
- Centres of Excellence (CoE) Programme.

Innovation Fund (IF)

The *White Paper on S&T, 1996* set the policy framework for the promotion of innovation. Innovation is defined as the successful production, assimilation and exploitation of novelty in the economic and social spheres.

The IF was created to promote technological innovation; increase networking and cross-sectoral collaboration and competitiveness, quality of life and environmental sustainability, and the harnessing of IT.

The IF addresses serious problems that could impede socio-economic development or affect the country's ability to compete in products and services. Through the IF and the Bioregional Innovation Centres (Brics), the department is focusing its efforts on establishing the institutional infrastructure, legislation and policy framework needed to integrate the process of knowledge creation and its subsequent commercialisation for national benefit.

Among other things, the fund promotes technological innovation through consortia of expertise drawn from both public and private sectors.

The instruments of the IF are specifically tailored to foster the pursuit of high-risk technologies by business entities, by creating partnerships that draw on technical expertise in the public research enterprise. The incentive to the business partners is the equal sharing of the R&D costs of the market-oriented research agenda.

The IF is managed by one of the science councils, the NRF. The fund provides funding to near-market and end-stage research, which produces new intellectual property (IP) and commercial enterprises, and expands existing industrial sectors.

HE students, particularly first-degree engineering students, can take advantage of the fund by developing, as part of their final-year work, projects resulting in the creation of new IP or the establishment and/or expansion of commercial enterprises.

The NRF claims a management and administration fee from the allocated budget for support services rendered.

Promoting niche areas

Space science

In July 2006, Cabinet approved the establishment of the South African Space Agency (Sasa) as an institutional vehicle to establish space S&T in South Africa. The country is increasingly reliant on space-based services, particularly those underpinning Earth observation, communications and navigation, and those that will contribute to making South Africa a regional hub of space S&T, especially in astronomy. The increasing geopolitical implications of national competence in space-related activities can change the future of provinces such as the Northern Cape. Legislation leading to Sasa was expected to be tabled in Parliament in 2007.

Astronomy

Through the Astronomy Geographical Advantage Programme, South Africa continues to promote high-technology investment in space science to ensure that local researchers and students are able to participate in international astronomy.

A key result was the launch of the Southern African Large Telescope (Salt) in November 2005, in Sutherland in the Northern Cape.

Salt is a multimillion rand project involving Germany, Poland, the United States of America (USA), New Zealand and the United Kingdom (UK). Salt is the largest single optical telescope in the southern hemisphere.

South Africa has been shortlisted, along with Australia, as one of the sites for the world-class radio telescope, the Square Kilometre Array (SKA). A final decision in this regard is expected in 2008.

The SKA will be the biggest telescope ever built, the only one of its kind worldwide, and the only instrument able to answer the most basic questions of the origin of the universe and the birth and evolution of stars and galaxies. It will investigate the origin of magnetism in the universe and will be the most powerful instrument ever to search for extraterrestrial intelligence.

South Africa has assembled a team to build the Karoo Array Telescope (Kat). The Kat team and researchers in the UK, the Netherlands, Australia and the USA are developing digital signal processing for the telescope, and software and innovative telescope antennas, using composites.

The SKA and Kat projects are important for developing high-level skills and expertise in South Africa.

The Department of Science and Technology has provided funding for graduate study associated with these projects. Twelve postgraduates were provided with funding in 2004/05. A further 11 recipients were identified in 2006. By mid-2006, there were 20 students participating in this programme, carrying out research for PhD and MSc degrees at South African universities, and two postdoctoral fellows.

This programme is being extended to South Africa's partners in the SKA bid – Botswana, Ghana, Kenya, Madagascar, Mauritius, Mozambique and Namibia.

The 2007/08 budget allocated R500 million, both for the SKA and for the construction of the Kat, which will in turn provide the means to train scientists and engineers to acquire relevant capabilities and skills.

The Kat team has already been recognised for its competence and is being called upon to assist and advise the international SKA project office on system engineering, costing and other key technology areas.

The team is playing a leading role in collaboration with researchers in the UK, the



In March 2007, six scientists from South Africa's University of the North West were part of an international team that scooped the European Union's (EU) prestigious Descartes Prize for their ground-breaking research on the Earth's galaxy via gamma rays.

The recipients of the Descartes Prize for Research, announced in Belgium, were Okkie de Jager, Christo Raubenheimer, Christo Venter, Matthew Holleran, Namibian astronomer Isak Davids, and German postdoctoral astronomer Ingo Buesching.

The six scientists are part of an EU-funded team of about 100 who run the High-Energy Stereoscopic System (Hess), comprising four telescopes in Namibia that were specially developed for the study of gamma rays.

The South African Government invested over R30 million in the construction of the telescopes, has contributed millions more to establishing the Hess site which is near the Gamsberg, and is funding South Africa's participation in the project.

Netherlands, Australia and the USA, in developing digital signal processing for the telescope, developing software and, in partnership with the industry, developing innovative telescope antennas using composites.

In support of the astronomy programme, the department was expected to submit the Astronomy Geographic Advantage Bill to Parliament in 2007, which will enable the introduction of measures to protect the sensitive astronomy sites and maintain South Africa's geographic advantage.

The construction of the low-Earth observation satellite, SumbandilaSat, was completed on time and handed over to the department in November 2006.

In 2007, nine black engineering interns were expected to finish building the training model satellite. At the same time, the department had commissioned the technology development of a new sensor, which it expects to use in a future remote-sensing satellite.

Biotechnology

The National Biotechnology Strategy (NBS), which was launched in 2001, sets the agenda for the development of South Africa's biotechnology industry.

AsgiSA has identified biofuels as a potential contributor to rural development. This includes the establishment of sustainable rural jobs, both in the agricultural sector and in the processing of biofuels. Efforts are under way to examine the introduction of biofuels in the commercial transport

sector, as a way of stimulating a biofuels industry in South Africa.

However, such a strategy needs to be complemented by other biofuels-related initiatives that will enable the products to be used beyond the commercial transport fuel sector. One such initiative is the local production of biofuels for local users. Internationally, this has taken the form of the development of a local biofuels industry that supplies fuel for running public transport.

This project will explore the potential of such an approach through the deployment of appropriate technology and initiation support for R&D activities. Results of this project should serve as a benchmark and model for public transportation.

Nevertheless, the biotechnology sector is attracting a fast-growing portion of R&D funding. Funding for genetic engineering grew by 360% between 2002 and 2004. Investment growth in the related fields of biochemistry, genetics, molecular biology, microbiology, genetic engineering and biotechnology exceeded 46%.

The department is also committed to developing biotechnology in Africa. In August 2005, the Council for Scientific and Industrial Research (CSIR) initiated a southern regional hub of the New Partnership for Africa's Development's (Nepad) African Biosciences Initiative.

Research related to agriculture, human and animal health, environment and industry is being prioritised. Other initiatives include the establishment of Brics, namely: Biotechnology Partnership for Africa's Development (Biopad), Cape Biotech, LIFElab and the Plant Biotechnology Innovation Centre.

Brics were created as instruments for implementing the NBS. Their focus areas cover a wide spectrum of subdisciplines in biotechnology. These include human and animal health, biopharmaceuticals, industrial bioprocessing, mining biotechnology, bio-informatics and plant biotechnology.

One of the challenges facing the South African biotechnology sector is the public's lack of understanding and knowledge of biotechnology applications and benefits.

As a result, the Public Understanding of Biotechnology Programme was initiated to provide South Africans with information, enabling them to participate meaningfully in debates about biotechnology and to make informed decisions in this regard.

In addition, the implementation of the NBS has seen the development of the National Bio-



In September 2007, the International Centre for Genetic Engineering and Biotechnology (ICGEB) opened its third major laboratory in Cape Town, which will focus mainly on the development of new vaccines against serious infectious diseases which afflict Africa, such as HIV and AIDS, malaria, hepatitis B and C, and tuberculosis.

The laboratory, situated at the Groote Schuur Hospital, joins sister laboratories in Trieste, Italy, and New Delhi, India, in serving as the 74-country organisation's international facilities for high-quality scientific research and training in the field of bioscience.

The Cape Town component of the ICGEB will eventually be expanded to advance knowledge and apply latest techniques in the fields of biomedicine, crop improvement, environmental protection and remediation, biopharmaceuticals and biopesticide production.

The Department of Science and Technology will contribute approximately Euro four million toward the costs of the Cape Town laboratory over the next four years.

Informatics Network (NBN) at eight universities, investing in technology R&D, infrastructure and teaching.

In 2005, 71 students (51% of whom were women and 34% of whom were black) received training in biotechnology-related subjects.

The results of biotechnology investments have long lead times, sometimes up to 15 years, yet some success stories resulting from the investments and interventions made by the biotechnology institutions are already being reported.

The goal is to expand the country's biotechnology platform and develop a bio-economy base.

Indigenous Knowledge System (IKS)

Since government launched the IKS policy in 2004, a number of successes have been achieved on key cross-cutting issues. This includes the timely establishment of the Ministerial Advisory Committee, which will assist in establishing IKS chairs to be located within HE institutions, based on nationally prioritised areas such as traditional medicines, knowledge studies and indigenous food security.

In March 2007, South Africa and the Ministry of Science and Technology of Zambia successfully hosted the second Southern African Development Community (SADC) workshop on IKS policy development in the region. Emanating from this workshop was a number of recommendations for member states, including the need to harmonise the region's policy framework within the next two years.

Government plans to develop IKS databases, following an audit of those residing at various institutions. It is also envisaged that a hardware multimedia recording system to capture documentation, such as the registration of holders of indigenous knowledge, interviews and satellite-information linkages, will be developed.

By mid-2007, the first pilot IKS centre was being established at the University of Zululand. It will support the IKS Laboratory on Traditional Medicines at the Medical Research Council (MRC).

Public funding

The provision of public funding is a key component of government's responsibility of creating an

enabling environment for R&D. To track investments, government has initiated a process whereby a national R&D survey is conducted every year.

The link between government and industry is crucial. Current human-capital programmes have introduced research chairs with industry partnerships to strengthen this linkage.

The first group of scientists appointed as university research chairs, an initiative that aims to attract top minds and reverse the declining research output, was announced in 2006.

The South African Research Chair Initiative (Sarchi), was officially launched in September 2007. It aims to invigorate HE research institutions,

By September 2007, the initiative was supporting 59 master's and PhD students under the tutelage of 21 round-one research chairs. The department planned to award another 51 research chairs by the end of 2007.

Working with the National Advisory Council on Innovation (Naci), the department has produced a comprehensive report on the infrastructure requirements for both science and innovation. This will form the basis of a long-term infrastructure plan for S&T.

Other infrastructure projects that government is expected to benefit from include the Centre for High Performance Computing (CHPC), nanotechnology characterisation centres, astronomy and space science. Regarding nanotechnology and nanoscience, government is in the process of creating the physical infrastructure that will enable first-class basic research, exploration of applications, the development of new industries and the commercialisation of innovations.



The Digital Doorway Project is an effective tool in bridging the digital divide.

Some 150 units give thousands of young people, who have no access to computers in their schools or homes, the opportunity to develop computer skills and to access valuable information. The project is a joint initiative of the Department of Science and Technology, the Council for Scientific and Industrial Research and Eskom.

Policy and initiatives

National Research and Development Strategy

The NRDS is an enabling framework for South Africa's innovation system to prioritise economic sectors with growth potential, such as biotechnology, nanotechnology, IT and space technology. The strategy has enabled government to increase investment in human capital to transform and fill the skills gaps identified in key sectors.

More focused sector strategies, such as the Biotechnology Strategy, the Advanced Manufacturing Technology Strategy (AMTS) and the Nanotechnology Strategy, were formulated. A need was identified to enhance the research infrastructure to create a knowledge workforce for advanced technology businesses, and so support the country's future competitiveness and its ability to achieve an improved quality of life.

Projections of future R&D spending show that in 2008, when it is anticipated that GDP would have reached about R1 991 billion, an additional R6 billion would be required for investment in R&D to attain the 1% of GDP target.

The NRDS focuses on three broad areas:

- Innovation, primarily through technology missions: The emphasis is on technological innovation, demonstrating technology, incubating new technology-based businesses and enhancing networks of knowledge workers and organisations in specific areas of technology.
- Strengthening SET, HR and transformation: The emphasis is on establishing CoEs, establishing and funding networks for Nepad and the SADC, strengthening global science networks, formulating strategies aimed at sourcing new finance for R&D equipment, strengthening institutional and individual research capacity in science focus areas through the NRF, and increasing public understanding and engagement.
- Creating an effective government S&T system: A clear distinction needs to be drawn between the roles of line-function departments and the integrative role of the Department of Science and Technology. This focus area is involved in generating three-year R&D plans for science councils in line with the Medium Term Expenditure Framework (MTEF) process, developing standard-reporting frameworks and a performance-management system for all institutions, and giving the department central responsibility for producing an integrative budget for all S&T initiatives.

The six CoEs are:

- Biomedical Tuberculosis (TB) Research
- Invasion Biology
- Strong Materials
- Birds as Keys to Biodiversity Conservation at the Percy Fitzpatrick Institute
- Catalysis
- Tree Health Biotechnology at the Forestry and Agricultural Biotechnology Institute.

Advanced Manufacturing Technology Strategy

The AMTS was launched in October 2003. It guides efforts in the manufacturing sector, including the aerospace industry. The AMTS strives to:

- develop technology platforms that increase current and create new competitive advantages
- establish partnerships and human-capital development.

The aim is to enhance the knowledge base and the knowledge intensity of South Africa's manufacturing sector.

In 2006, the Department of Trade and Industry launched the National Aerospace Centre of Excellence, located at the University of the Witwatersrand.

The Centre for Innovation, focusing on craft and design, opened in Cape Town in July 2006. The centre is the first of its kind in the world and a state-of-the-art resourced venue aimed at promoting innovative design, product development and process technologies for crafters and designers.

The Cape Craft and Design Institute (CCDI) spearheaded the creation of the centre, together with the Western Cape Provincial Government and the AMTS.

The Centre for Innovation incorporates a fabrication laboratory, sponsored by the Massachusetts Institute of Technology (MIT). The centre's activities are linked to the CCDI's small, medium and micro-enterprise (SMME) development and market-access support programmes.

Government has set aside R16 million to establish 10 fabrication laboratories (FabLabs) around the country, providing disadvantaged communities with opportunities in the design, testing and fabrication process.

FabLabs form part of the department's goal of providing SET platforms for social development, while benefiting private-sector competitiveness and growth.

Advanced manufacturing technology is brought to ordinary people as an accessible platform to

empower them by hands-on participation in an environment that enables the freedom to experiment, and encourages peer-to-peer learning. The platforms provide the means to solve local problems innovatively and stimulate creativity that should lead to technopreneurship options.

FabLabs are also sponsored by the MIT's Centre of Bits and Atoms, where it was originally developed. By August 2007, six FabLabs were operational throughout South Africa in Pretoria, Soshanguve, Cape Town, Bloemfontein, Potchefstroom and Kimberley.

South African National Energy Research Institute (Saneri)

Cabinet approved the establishment of the Saneri in 2004. It was officially launched in February 2007.

The Central Energy Fund houses the institute, jointly run by the departments of minerals and energy and of science and technology. It conducts research on the energy sector.

The Saneri, through R&D, provides for:

- cost-effective and efficient energy generation, transformation, transport, end-use and decision-support technologies
- energy-technology innovation
- sustainable development and use of energy resources
- improving the quality of life of all South Africans
- promoting and conducting training of energy researchers
- establishing and expanding industries in the field of energy
- commercialising energy technologies resulting from its R&D and innovation programmes.

Saneri established the Renewable and Sustainable Energy Research and Development Hub at the University of Stellenbosch.

The hub will support the development of a vibrant renewable and sustainable energy-supply industry in South Africa.

Pebble Bed Modular Reactor (PBMR)

PBMR (Pty) Ltd of South Africa was established in 1999 to develop and market small-scale, high-temperature reactors, both locally and internationally. The 700-member PBMR project team is based in Centurion, near Pretoria.

The PBMR is a high-temperature reactor, with a closed-cycle, gas turbine power conversion system. The South African project is internationally regarded as the leader in the power-generation field. Better efficiency and attractive economics are possible without compromising the high levels of passive safety expected of advanced nuclear designs.

PBMR (Pty) Ltd's current investors are the South African Government, Eskom, the Industrial Development Corporation of South Africa and the US nuclear giant Westinghouse. The PBMR programme represents a significant development for South Africa in the field of nuclear S&T.

National Advisory Council on Innovation

The Naci is appointed by the Minister of Science and Technology to advise on the role and contribution of innovation, including S&T, in promoting and achieving national objectives. These include:

- improving and sustaining the quality of life of all South Africans
- developing HR for S&T
- building the economy
- strengthening the country's competitiveness in the international sphere.

Naci membership is broadly representative of all sectors and is constituted to ensure a spread of expertise and experience regarding national and provincial interests, scientific and technological disciplines, innovation regarding the needs and opportunities in different socio-economic fields, and R&D in all sectors.

Public understanding of Science, Engineering and Technology

The department's efforts in this regard include:

- The South African Reference Group on Women in S&T, established in March 2003. This ministerial body advises on ways to increase the visibility and development of women, and on making science more relevant to the needs of society by incorporating women's needs and expectations.
- The Women in Science Awards, first awarded in 2003, to honour female scientists and their achievements.
- National Science Week, an annual week-long event aimed at persuading the youth to pursue

careers in SET, while highlighting the important role that science plays in everyday life. The 2007 event was held from 12 to 19 May and the theme was *Tomorrow's Science and Technology are in our Youth's Hands*.

National Nanotechnology Strategy

The National Nanotechnology Strategy recognises the needs of local industry and focuses on the essential building blocks of nanoscience, namely synthesis, characterisation and fabrication.

The National Nanotechnology Strategy positions South Africa as a global player in this emerging area and seeks to strengthen government's integrated development focus.

The strategy aims to:

- support long-term nanoscience research that will lead to a fundamental understanding of the design, synthesis, characterisation, modelling and fabrication of nanomaterial
- support the creation of new and novel devices for application in various areas
- develop the required HR and supporting infrastructure
- stimulate new developments in technology missions, such as advanced material for advanced manufacturing, nanobiomaterial for biotechnology, precious metal-based nanoparticles for resource-based industries, and advanced material for information and communications technologies (ICTs).

The strategy is aimed at increasing the number of nanotechnology characterisation centres in South Africa. In 2007, National Treasury allocated R450 million to implement the strategy over the next three years.

Known as "the technology of the very small" (i.e. about 1/80 000 of the diameter of a human hair), nanotechnology comprises a wide range of technologies, techniques and multidisciplinary research efforts for application in a range of cross-cutting industries and activities.

These include aerospace, manufacturing and automotive industries; energy conversion, storage

and distribution; the hydrogen economy; chemicals; electronics and information processing; as well as biotechnology and medicines.

South African industry and researchers have been involved in nanotechnology and the practical application of nanoscience for several years, for example, Sasol's chemical processing by catalysis. New generations of emerging nanotechnology-based products require that South Africa develops its ability to derive more benefits from global advances in this area.

In this regard, human-capital development also forms a very strong and integral component of the National Nanotechnology Strategy. For this reason, the development of a highly trained HR base with R&D expertise will encourage the private sector to develop nano-based products and services.

The country's human-capital development programmes include the use of the Department of Science and Technology's Sarchi postgraduate programmes, as well as bursaries for students. The CSIR has taken the lead in this challenge. By mid-2007 it was training 19 nanotechnology postgraduate students (three master's, three postdoctorates and 13 PhDs).

Information and communications technology

South African researchers now have the advantage of using massive computing power in their quest for new knowledge and application.

The CHPC is the first of its kind in South Africa. Initiated by the Department of Science and Technology, hosted by the University of Cape Town and managed by the Meraka Institute of the CSIR, the CHPC is making scientific "supercomputing" a reality for South Africa.

The Minister of Science and Technology, Mr Mosibudi Mangena, officially opened the facility in Cape Town on 22 May 2007.

The CHPC supports a diverse base of researchers and scientists, and facilitates the collaboration and multidisciplinary approach needed to solve complex computational problems.

The centre will advance South Africa's research capabilities in areas such as advanced manufacturing, space science, and research into infectious diseases.

The high-speed computational infrastructure comprises 160 computer nodes (640 processors) in a clustered architecture. It is rated to have a peak performance of around 2,5 teraflops (2,5 million mathematical operations) every second.

It is complemented by 50 terabytes of storage space. To maximise the benefit and use of this



The winners of the 2007 Women in Science Awards were announced in August. The top award in the Distinguished Women Scientist category was won by Professor Susan Harrison from the University of Cape Town.

The Best Emerging Young Scientist Award went to Dr Nadine Strydom for her research in her unique field as a larval fish biologist.

infrastructure, the research communities in South Africa are self-assembled into 10 special-interest groups, and the CHPC will add significant computational power to accelerate the research agenda of these groups.

The CHPC and the South African Research Network are the backbone of an emerging cyber-infrastructure in South Africa that will support research initiated in other elements of the country's S&T infrastructure, such as the SKA, the NBN and the Global Earth Observation System of Systems (GEOSS).

The GEOSS aims to enable globally co-ordinated Earth observations across a number of domains, to provide better and more reliable data in areas of benefit to society, including agriculture, weather, climate, water, disasters, health, energy, biodiversity and ecosystems.

Tshumisano

Tshumisano was established in 2002 with the mandate to provide support for the SMME sector through its Technology Stations Programme.

One of the aims of this programme is to strengthen technological innovation activities and related skills upgrading, to increase the relative competitiveness of SMMEs in targeted sectors.

These sectors include automotive, agrifoods processing, electronics, metal value-adding, chemicals, metal casting, and composite and moulded plastics.

Technology stations are based at various universities of technology across the country. The approach is a two-way learning process in which SMMEs improve their operations through technology assimilation and by upgrading their innovation capabilities.

This process enriches the teaching and learning activities of universities of technology by improving their equipment and their real-world understanding of the industry challenges.

The Tshumisano Trust, a joint venture between government, the German Agency for Technical Co-operation and the Committee of University of Technology Principals, is generating stronger working relationships between the departments of science and technology and of labour.

Technology stations that fall under the control of the trust are listed below, along with the relevant host institution:



In May 2007, the Minister of Science and Technology, Mr Mosibudi Mangena, launched a database that is aimed at quantifying and monitoring the levels of unemployment among Science, Engineering and Technology (SET) graduates in South Africa. This is aimed at addressing the challenge of unemployment among graduates in this sector.

The database will be used by job seekers, potential employers, prospective candidates for postgraduate studies, institutions for higher learning and other stakeholders to improve the rate of human-capital development, especially in SET.

- Tshwane University of Technology (TUT): Electronics and Electrical Engineering, complemented by IT
- Central University of Technology: Metals Value-Adding and Product Development
- TUT: Chemistry and Chemical Engineering
- Mangosuthu Technikon: Chemistry and Chemical Engineering
- Vaal University of Technology: Material and Processing Technologies
- Nelson Mandela Metropolitan University: Automotive Components
- Nelson Mandela Metropolitan University: Downstream Chemicals
- Cape Peninsula University of Technology: Clothing and Textiles
- University of Johannesburg: Metal-Casting Technology
- Durban Institute of Technology: Reinforced and Moulded Plastics
- Cape Peninsula University of Technology: Agri-Food Processing Technologies.

By mid-2007, the Tshumisano Internship Programme had placed more than 50 interns within various technology stations.

Poverty reduction

The Department of Science and Technology believes in a multipronged approach to fighting poverty.

Its poverty-alleviation projects are having positive outcomes in businesses and co-operatives and focus on, among other things, bee-keeping, paper-making, incorporating African design in clothing and textiles based on natural fibres, and indigenous cattle production. These projects are concentrated in the poverty nodes as identified by

government's Integrated Sustainable Rural Development Strategy.

Internship Programme

The department and the NRF have jointly implemented and are managing a programme to provide work experience for unemployed graduates by providing them with practical and accelerated learning programmes towards building workplace competencies.

National Information Society Learnership Programme

The National Information Society Learnership Programme aims to contribute towards building an information society and promoting greater and more efficient use of IT.

Youth into Science Strategy

The Youth into Science Strategy primary objective is to contribute towards the development of the priority skills base.

Through this programme, the department will be recruiting young people to pursue careers in areas of scarce skills. Its targets include doubling S&T literacy among the youth and nurturing more than 5 000 young people with talent and potential in SET by 2010.

International science and technology co-operation

The strategy to use southern Africa's local (geographical) advantages and efforts to attract large international science-based investments is paying off. Examples include the construction of the High-Energy Stereoscopic System (Hess) observatory in neighbouring Namibia and the Salt in Sutherland in the Northern Cape, as well as winning the bid to host the European Developing Countries Clinical Trials Partnership (EDCTP). Added to this are bold efforts to bolster South Africa's bid to site the SKA in South Africa.

International breakthroughs include South Africa's leading role in the European Union's sixth framework programme, and in implementing Africa's Consolidated S&T Plan of Action.

South Africa is involved in developing an S&T platform in the subregion through the SADC Ministers' Council on S&T, which is developing a SADC protocol to guide the implementation of the subregional S&T plan.

Developing a high-speed broadband network in the region is a flagship project of the Department of Science and Technology. The UbuntuNet Project is

set to link through the South African National Research Network to Europe, via the Geant connection, to give South Africa and its research community a high-speed network. The first phase of implementing this network began with total funding of R178 million over the MTEF.

The department has successfully leveraged human-capital support through international S&T agreements. This has resulted in jointly funded projects with 16 countries in areas such as agriculture, manufacturing and biotechnology.

South Africa's role at the forefront of Nepad is, to a significant extent, based on its ability to deploy scientific knowledge and technological solutions on the continent.

In 2002, the International Council for Science (Icsu) decided to establish four regional offices in the developing world. In September 2005, the council's Regional Office for Africa was launched in Pretoria. South Africa hosts the office at the premises of the NRF.

The Department of Science and Technology leads the international process to establish the GEOS. Acting through the department, South Africa participated in developing the 10-year implementation plan and was elected co-chair of the Group on Earth Observations.

Heads of state and government met during the eighth ordinary session of the Assembly of the AU in Addis Ababa, Ethiopia, in January 2007. The focal theme was *Science and Technology, Climate Change and Sustainable Development in Africa*.

Each country pledged to devote 1% of its GDP to supporting R&D by 2010. They also endorsed the 20-year Biotechnology Action Plan, which calls for co-operation among African nations in specific regions to bolster research in different fields according to regional strength.

The heads of state designated 2007 as the "Year for Scientific Innovations". They also acknowledged the need to establish a single Pan-African Internet-provider organisation to protect indigenous innovations and urged all member states to lend full support to the implementation of such a decision. They also endorsed the need for both South-South and North-South co-operation in S&T and innovation, and to enhance Africa's role in international partnerships.

South Africa is on course in implementing these decisions and resolutions.

South Africa is hosting the Nepad focal points such as the African Laser Centre (ALC), the African Institute for Mathematical Sciences (Aims) and the biosciences initiatives. Every two years, the ALC hosts

summer schools co-funded by the USA-based National Science Foundation, and Aims is establishing a network of institutes on the rest of the continent.

South-South co-operation has been strengthened and enhanced by fostering partnerships with the countries of the south, and in particular African countries. South Africa is spearheading a number of bids to host significant international facilities in Africa and is doing so in collaboration with its partner African countries.

This is how government approached the decision to host the regional offices of the World Association for Industrial and Technical Research Organisations, Icsu, the third component of the International Centre for Genetic Engineering and Biotechnology and the EDCTP. In the same spirit, government is working towards winning the bid to host the SKA radio telescope in partnership with, and for the benefit of, the entire continent.

The HIV and AIDS, TB and Malaria clinical trials (ATM) Registry was launched in May 2007, as part of the African Contributors Meeting hosted by the South African Cochrane Centre and the MRC.

The ATM Registry will be a global resource for researchers, clinicians, policy-makers and the public, by:

- providing a source of reliable information on the efficacy and safety of prevention and treatment measures
- identifying research gaps that should be addressed in future trials
- providing a laboratory for studying the scope, quality and funding patterns of trials
- keeping track of ongoing trials.

National Research Foundation

With ring-fenced allocations of R54 million, R66 million and R44 million for the MTEF period, the NRF is a key public entity responsible for promoting and supporting the development of HR for research, technology and innovation in all fields of S&T. The NRF carries out its missions by:

- providing seven unique national research facilities
- promoting science awareness through the South African Agency for Science and Technology Advancement (Saasta)
- making and managing merit-based grants and co-operative agreements with individual

researchers, research groups, and institutions locally, regionally and internationally (through the Research and Innovation Support Agency)

- delivering unique knowledge-management services to the research community.

The NRF focuses on contributing to government's strategy to create wealth and improve citizens' quality of life.

Doctoral graduates are the platform upon which social and technical progress, innovation and business performance can flourish.

The key driver for all the NRF's activities is the production of large numbers of highly skilled people who can generate new knowledge, develop and use new technologies, and innovate and drive the competitiveness of the country in international world markets.

The NRF regards HR development as a long-term investment in growing the pool of resources by drawing in learners who will become scientists and innovators.

SET education, through pre-tertiary, tertiary and lifelong learning initiatives, provides the basis for creating the required human capital for South Africa's SET endeavours. Saasta's contribution to the NRF vision is to grow the pool of quality learners who will become the scientists and innovators of the future.

Science-advancement programmes within the NRF reside under three interdependent strategic areas:

- building the supply of tomorrow's scientists and innovators through education-related programmes
- celebrating South African achievements in S&T and building the public's appreciation of the benefits of science through science communication
- using interactive exploration, engagement and exhibitions to instil enthusiasm about the wonder and application of SET, while encouraging greater public engagement in SET issues.



In April 2007, South Africa hosted the seventh World Nano-Economic Congress. It was the first time the congress had been held in this country.

Through a series of integrated programmes, Saasta is developing an infrastructure that supports high-impact activities and science-promotion sites.

The NRF manages the following research facilities:

South African Astronomical Observatory (SAAO) and Southern African Large Telescope

SAAO is the national research facility for optical/infrared astronomy in South Africa. Its primary function is to further fundamental research in astronomy and astrophysics at national and international level.

In 2005, SAAO made the transition from the Salt construction phase to the Salt operation phase. By devising a vastly superior spherical aberration corrector, and a variety of other innovations, SAAO has contributed to making Salt more capable than its counterpart, the Hobby-Eberly Telescope in Texas, USA.

From the outset, Salt was conceived as an African facility. With the advent of large-scale facilities such as Salt and Hess, and other initiatives such as the SKA, Inkaba ye Afrika and ZASat, southern Africa is emerging as a regional space S&T hub.

Hartebeesthoek Radio Astronomy Observatory (HartRAO)

HartRAO is responsible for research and training in radio astronomy and space geodesy in South Africa. The 26m-diameter radio telescope is available for research either as a single, independent instrument or in global networks of radio telescopes, using the technique of very long baseline interferometry (VLBI).

HartRAO is one of only six permanent fundamental space geodesy stations worldwide and participates in geodetic VLBI, through the International VLBI Service, in satellite laser ranging (through the International Laser Ranging Service), and in the Global Navigating Satellite System (GNSS) (through the International GNSS Service). The data is available to the international community.

The radio astronomy group is part of the National Astrophysics and Space Science Programme for postgraduate students.

It is involved in developing the SKA and its South African prototype, Kat. Research collaborations are in place with southern African countries and overseas institutions.

Hermanus Magnetic Observatory (HMO)

The HMO functions as part of the worldwide network of magnetic observatories. Its core function

in this regard is to monitor and model variations of the Earth's magnetic field. The scope of the HMO's activities also includes fundamental and applied space-physics research, science outreach and the provision of geomagnetic field-related services on a commercial basis. To facilitate achieving its objectives, the HMO is structured into three operational groups: Geomagnetism, Space Physics and Technology. Science outreach falls under the Space Physics Group.

The objectives of the HMO include:

- providing geomagnetic field data and information in accordance with intermagnet standards
- providing ionospheric and space-environment data in accordance with international benchmarks
- being at the forefront of space-physics research
- human-capacity development
- providing quality-controlled magnetic-field-related services to clients in the defence and aerospace industries.

South African Institute for Aquatic Biodiversity (Saiab)

Saiab is an interactive hub, focused on serving the nation by generating, disseminating and applying knowledge towards understanding and solving related conservation problems and the wise use of African fish and aquatic biodiversity. Saiab cares for and develops the National Fish Collection, generates knowledge through research on aquatic biodiversity in Africa, and trains and educates knowledge workers in aquatic biodiversity.

It addresses national and international issues in aquatic biodiversity, through the priorities set by national and international funding agencies.

The Deputy Minister of Science and Technology, Mr Derek Hanekom, launched the National Fish Collection in March 2007.

Completed in 2006, the facility stores about a million marine, estuarine and freshwater fish specimens collected during field trips, and received as gifts and exchanges from other research organisations and museums around the world.

Unique to the National Fish Collection, the Saiab also boasts an unusual albino great white shark, caught by fisherfolk off the East Cape coast. The development of modern facilities, such as the National Fish Collection, is expected to play a critical role in shaping the future of research on aquatic biodiversity in South Africa.

Science challenges for Saiab include building the flagship African Coelacanth Ecosystem Project,

developing biosystematic capacity, and developing an effective and integrated information-management system. Saiab has an active rural outreach programme, the Bright Spark Club, which identifies high-potential candidates for science careers and gives them career-forming experiences over one year.

South African Environmental Observation Network (Saeon)

Saeon aims to generate and archive reliable long-term information, relevant to the sustainable management of natural resources and habitat, over a range of ecoregions and land uses. These include pristine (wild) landscape, partially pristine (managed) landscape, agriculturally (rural) transformed landscape and urban transformed landscape.

Saeon establishes innovative research platforms and information-management systems for long-term multidisciplinary, multi-institutional and participatory ecosystem studies, with strong regional and global linkages. These research platforms are co-ordinated as nodes, with the first one – the Ndlovu Node – established during 2004 in Phalaborwa.

The second, the Elwandle Node, covers the coastal-inshore zone and was established in 2006 in Grahamstown, Eastern Cape.

The launch of the saeon fynbos, the marine-offshore, the arid lands and the grasslands/forests/wetlands mosaic nodes are in the pipeline. Saeon is founded on three pillars, namely observation sciences, information-management systems and science-education outreach. It also runs an innovative education-outreach programme that focuses on educators, learners and postgraduate students.

National Zoological Gardens (NZG)

The NZG was declared a national research facility in April 2004. It has since been engaged in a strategic reorientation process to align with, and contribute to, the NRF's core missions and strategic priorities.

The NZG is changing from being a traditional zoological garden, to becoming a national facility for, and an active participant in, terrestrial biodiversity research. It has the potential to offer South Africa, Africa and the international

community the infrastructure required to conduct world-class and knowledge-generating research.

The NZG houses one of the largest animal collections in the world. It operates two biodiversity-conservation centres (in Lichtenburg and Mokopane) and a second zoo and game park in Vanderbijlpark. Including the NZG in Pretoria, the area managed by the NZG totals 7 730 hectares. The NZG is well placed as an education platform, receiving close to 600 000 visitors a year. (See Chapter 8: *Environmental affairs and tourism*)

iThemba Laboratory for Accelerator-Based Sciences (iThemba Labs)

iThemba Labs is a multidisciplinary research centre and provides facilities for:

- basic and applied research using particle beams
- particle radiotherapy for the treatment of cancer and other life-threatening lesions
- the supply of accelerator-produced radioactive isotopes for nuclear medicine and research.

iThemba Labs brings together people working in the medical, biological and physical sciences who are interested in using accelerated particle beams, by providing opportunities for research and postgraduate training in these separate disciplines, and also by stimulating mutual interest in interdisciplinary areas.

iThemba Labs has an "open-door" policy towards training postgraduates and in-service trainees.

While postgraduates from universities all over South Africa use the facilities, iThemba Labs proactively participates in building research and postgraduate capacity at historically disadvantaged institutions.

Research and Innovation Support Agency (Risa)

Risa aims to support and promote research and research-capacity development in all fields of knowledge and technology, including the natural sciences, social sciences, humanities, law, engineering, technology and IKS.

This is done by:

- investing in knowledge production and promoting basic and applied research, technology development and innovation
- developing research capacity and advancing

equity and redress to unlock the full creative potential of the research community

- investing in research infrastructure
- facilitating strategic partnerships and knowledge networks.

Much effort has been directed towards ensuring that Risa-supported research focuses on areas that are relevant to South Africa's developmental challenges, in a rapidly changing, highly competitive and knowledge-driven environment.

Support functions

Risa's granting functions are focused on:

- advancing and strengthening strategic knowledge
- identifying distinct South African research opportunities
- conserving and managing ecosystems and biodiversity
- promoting economic growth and international competitiveness
- advancing education and the challenges for change
- supporting IKS
- advancing ICT in South Africa
- establishing the socio-political impact of globalisation and the challenge for South Africa
- eradicating poverty.

Within these focus areas, knowledge fields that may be weak are developed in conjunction with the research community. Research agendas are established through interaction with the research community and collaboration between disciplines is promoted.

Risa implements the following interventions to achieve its goals:

- Student support through a range of different offerings:
 - Block grants are provided to HE institutions to be distributed to worthy postgraduate students who meet certain performance targets. This mode of operation is used to ensure the speedy delivery of funds to students, who are the lifeblood of the research system.
 - Two complementary programmes of postgraduate student support, namely free-standing scholarships, awarded directly to postgraduate students for studies locally and abroad; and grantholder-linked bursaries, granted to researchers within their NRF support package, and which may be awarded to students selected by the NRF grantholder.
- The Department of Labour, in conjunction with the departments of education and of science

and technology, is responsible for ensuring HE training in scarce skills. The Department of Labour allocates resources from the National Skills Fund to the NRF for bursaries and scholarships. The NRF created the Scarce Skills Fund to promote and support students who study at postgraduate levels in areas where skills are scarce. This fund also provides funds to postgraduate students with disabilities.

- Support of postdoctoral fellows through a range of different offerings, including the:
 - Innovation Postdoctoral Fellowship Programme
 - NRF Postdoctoral Programme, which supports and encourages doctoral candidates to embark on further research.
- Staff development at HE institutions is promoted through the Thuthuka Programme, which provides support for researchers in training, women in research and the Research Development Initiative for Black Academics.
- The Institutional Capacity-Development Programme focuses on linking and assisting institutions committed to research through institutional interventions and through funding finely focused research areas at these institutions.
- Within the focus-area programmes, researchers or teams of researchers can obtain up to two-year or five-year grants, depending on their individual ratings in an open competition.
- Sarchi aims to free academics to focus on research, thus increasing the number of world-class researchers and their output, to make South Africa internationally competitive. Up to R2,5 million a year can be awarded to a chair to cover salaries, postdoctoral and student awards, running costs and small equipment purchases. The aim is to support 210 chairs by 2010.
- The CoE Programme supports strategic, long-term research by providing secure and stable funding to outstanding researchers and their research groups when undertaking multi-institutional and cross-disciplinary research.
- The Technology for Human Resources for Industry Programme (Thrip) supports projects that address



In May and July 2007, South Africa hosted the Max Planck Science Tunnel; a 1 000-m² travelling international science exhibition.

The exhibition offered tours of present-day and future scientific discoveries and innovations, including digital and video displays of major scientific breakthroughs in important research areas in all major science areas.

the technology and HR needs of the industry on a cost-sharing basis with industrial partners. The programme focuses on increasing participation by SMMEs, Black Economic Empowerment entities, and black and female researchers and students, as well as encouraging collaboration between small and large firms.

- Thrip fosters industry-academia collaboration by subsidising industry research conducted by students. Many successful enterprises have been created through this programme. Not only has Thrip brought more money for university research, it has also successfully funded hundreds of postgraduate students. Since its inception 16 years ago, Thrip has made an important contribution to skills development, supporting on average 2 400 tertiary students each year. Its funding has now reached the billion Rand mark, an amount that has been matched and exceeded by industry.
- The IF invests in technologies at various stages of development. Some of the funding instruments of the IF fund the “proof of concept” phase of projects. The IF also provides seed-funding for commercialising IF projects and establishing technology-based start-up companies. The IF offers commercialisation advice to potential entrepreneurs, and promotes and stimulates the patenting of technologies and products.
 - The S&T Agreements Fund supports agreements that facilitate international research collaboration, specifically with African countries. The Department of Science and Technology is responsible for negotiating binational or multilateral agreements with international partners, and for drafting framework programmes. The NRF also has an independent responsibility for negotiating bilateral agreements with counterpart agencies. These agreements develop relations between the research communities of the intergovernmental and interagency signatories, and establish long-term co-operation between researchers.
 - Equipment grants allow HE institutions, museums and government-supported research institutions, such as science councils, to acquire research equipment, either of a general nature

or in focused fields, such as nanotechnology and laser technology.

- Mobility grants afford students and researchers the opportunity to obtain access to equipment at other local and international HE institutions. Support is also given to the in- and outbound travel expenses of researchers for participation in international conferences, and the limited sponsorship of various scientific events.
- Risa also works in partnership with various organisations to support their research needs. Examples of these include:
 - Initiatives linked to the biodiversity science thrust of the NRDS. These include the South African Biodiversity Initiative and the South African Biodiversity Information Facility. Risa manages the Sea and Coast Programme with the Department of Environmental Affairs and Tourism as a co-investor.
 - The NRF also manages the provincial research projects of the Marine and Coastal Management Branch of the Department of Environmental Affairs and Tourism. These projects have a strong applied-research focus, feeding into the management of marine and coastal resources, including resource allocations for the fishing industry.
 - The South African National Antarctic Programme aims to create a demographically balanced Antarctic research programme that strives for high-quality international research, and links to other African countries and interdisciplinary research.

Promotion functions

The promotion of research and research-capacity development also involves a number of separate initiatives. Knowledge fields that may be weak or underdeveloped are encouraged and stimulated in partnership with the relevant research community. Research agendas are established through interaction with the research community, and collaboration between disciplines is promoted.

Risa offers a performance-assessment service to the research community. This service assesses the quality of individual researchers from all fields of scholarly pursuit.



The so-called rating system uses international peer review to benchmark the quality and impact of previous research output, and assigns one of six ratings to individual researchers.

These ratings qualify applicants for extended periods of research support and in limited cases, guaranteed support. They are also used by HE institutions in the development of their staff members.

Another promotional service offered by Risa is the evaluation of research programmes or even research disciplines. This service is achieved through the facilitation of independent and informed assessment of the quality and value of programmes through peer review. The outcomes of the assessments, which normally contain recommendations for improvement of the programmes, are given to the relevant authorities to act upon, for the good of the entire research and innovation system.

Risa also generates, acquires and provides information that is useful for the production of new knowledge, such as the:

- Nexus Database System, which is a database of current and completed research projects and contains abstracts on 137 000 projects, in all science domains, from the year 1900 onwards
- Research Organisations' Database, which contains information on research organisations in South Africa
- Professional Associations' Database, which contains information on 180 associations, with contact details and disciplines
- conference website, which facilitates access to other conference databases on the Internet
- Women-in-Research Database, which facilitates collaboration between female researchers
- NRF-funded Projects Database, which reflects the grants of the foundation
- South African Data Archive, which is a large data archive of computerised social-science data.

Science councils

The statutory science councils are a key part of South Africa's NSI. Through them, government is able to directly commission research in the interest of the nation, and to support technology development in its precompetitive phase.

Agricultural Research Council (ARC)

The ARC is a statutory body established in terms of the Agricultural Research Act, 1990 (Act 86 of 1990). It comprises research institutes that were previously part of the Department of Agriculture, the oldest of which dates back to 1902.

As the principal agricultural research institution in South Africa, the ARC is committed to agricultural research, technology development and technology transfer within the macroframework of the agricultural sector, thereby contributing to the quality of life of South Africans.

The ARC's research goals are aligned with the objectives of the Strategic Plan for South African Agriculture.

The ARC's research activities address major government priorities, namely integrated rural development, natural-resource management, job creation, regional integration, urban renewal, HR development, crime prevention, farmer settlement, support-service improvement, infrastructure development, food security, and trade development and support.

The ARC comprises the following business units:

Natural Resource and Engineering Business Division

ARC-Institute for Soil, Climate and Water (ARC-ISCW)

Established in 1902 as the Division of Chemistry, the ARC-ISCW (in Pretoria, Gauteng) is a leading centre of expertise in the fields of soil science, agrometeorology, spatial modelling, soil-water science, geoinformatics (remote sensing, geographic, spatial and other information systems) and analytical services.

It is committed to improving rural livelihoods and agricultural productivity, and to the sustainable use of natural resources, soil, climate and water. The ARC-ISCW is the custodian of the Soil Information Systems, the Agrometeorological Climate Network and Databank, and the Coarse Resolution Satellite Imagery Database.

ARC-Institute for Agricultural Engineering (ARC-IAE)

The core purpose of the ARC-IAE (in Pretoria) is to develop and apply agricultural engineering technology that will contribute to higher yield, higher income and lower input costs for agriculture and related industries in a sustainable way.

The ARC-IAE is active in the agricultural engineering field and focuses on agricultural mechanisation, resource conservation, farm structures, irrigation, alternative energy, aquaculture and product-processing. Research is directed at a wide range of clients, from subsistence farmers using animal traction, to commercial farmers and manufacturers requiring scientific performance evaluations of advanced equipment.

ARC-Plant Protection Research Institute (ARC-PPRI)

The PPRI addresses agricultural and environmental concerns, through research aimed at promoting economic and environmentally acceptable pest-management strategies.

Fields of expertise include:

- biosystematics, ecology and epidemiology of invertebrates, fungi, pathogenic and useful bacteria and viruses
- the use of integrated pest management in the control of pests, diseases and invasive weeds
- beneficial organisms such as biological control agents, nitrogen-fixing bacteria, insect pollinators and bees.

The institute is mandated to address plant-protection issues that cut across commodities, affecting many crops and regions. Its research impacts on all South Africa's provinces and addresses the needs of many African countries.

Research is directed at commercial and resource-poor farmers to address current and anticipated threats. It also provides support for the benefit of researchers, agricultural industries and to governments to carry out their statutory obligations.

Grain and industrial crops***ARC-Grain Crops Institute (ARC-GCI)***

The ARC-GCI (in Potchefstroom, North West) is responsible for research into improving and cultivating grain crops such as maize, sorghum and millet, as well as oil and protein seeds such as sunflower, ground-nuts, soybeans, dry beans, cowpeas, sweet white lupin and bambara. Research activities involve plant breeding, evaluation of cultivars and grain quality, plant physiology, plant pathology, nematology, entomology and tillage.

ARC-Small Grain Institute (ARC-SGI)

The ARC-SGI (in Bethlehem, Free State) concentrates on improving and cultivating small grain crops such as wheat, barley, oats, triticale and rye.

Research activities include breeding new cultivars with better resistance to diseases and pests, the national evaluation of cultivars and grain quality, plant physiology, tillage, weed science, plant pathology, entomology and yield potential.

The ARC-SGI is the only institute of its kind that offers one-stop small-grain information, not only to the commercial farmer, but also to new, emerging and small-scale farmers.

ARC-Institute for Industrial Crops (ARC-IIC)

The ARC-IIC (in Rustenburg, North West) is involved in fundamental and applied research in the interest of the cotton and tobacco industries. Research is also conducted on other fibre crops such as hemp, sisal and flax, as well as on finding indigenous fibre crops with economic potential as new alternative crops in rural areas.

Likewise, certain crops are being investigated for their potential as sources of essential oils or household utilities. Research on cassava is directed at its potential as an alternative food source, and source of starch for industrial use. Research on pigeonpea and the promotion of this crop as an additional source of protein, is being widely conducted in rural areas.

Horticulture***ARC-Institute for Tropical and Subtropical Crops (ARC-ITSC)***

The ARC-ITSC (in Nelspruit, Mpumalanga) is responsible for research into all aspects of the cultivation of tropical and subtropical fruits.

Other crops into which production research is conducted include coffee, herbs and spices, medicinal plants, and pecan, macadamia and cashew nuts. Lesser-known exotic crops being evaluated are pitanga, feijoa, annona types, carambola and jaboticaba.

ARC-Roodeplaat Vegetable and Ornamental Plant Institute (ARC-VOPI)

The ARC-VOPI (near Pretoria) concentrates on a wide range of horticultural crops. Research is conducted on commercial vegetables such as onions, potatoes and sweet potatoes. Traditional and indigenous vegetables receiving attention include amaranthus, cassava, plectranthus, Zulu round potato, pigeon peas, cowpeas and bambara. Research into the production and development of ornamentals and indigenous flora such as fynbos, woody ornamentals and bulbs, has led to a new growth industry.

ARC-Infruitec/Nietvoorbij (Institute for Fruit, Vine and Wine)

ARC-Infruitec/Nietvoorbij (in Stellenbosch, Western Cape) does research, development and technology transfer pertaining to the following commodities: deciduous fruit (apples, pears, peaches, plums, apricots and nectarines); grapes (wine, table and raisin); alternative temperate climate crops (cherries, mushrooms, nuts, olives, persimmons, figs, berries and others); brandy; dried fruit and processed fruit.

Increasing attention is also being paid to indigenous crops (honeybush tea, rooibos tea and kei-apple) and their general use, processing and health-promoting abilities. The breeding and evaluation of new stone and pome fruit, as well as table-grape cultivars, is a major research effort. Progeny from the various breeding programmes continue to succeed on the local and export markets.

Traceability and authenticity have become major concerns in modern trade, particularly for sophisticated markets in the first world. Developing the ability to analytically prove the authenticity of South African wine and brandy is the goal of a second major research intervention. Data from isotopic and trace-element analyses will be used to compile reference databases for use in authentication and fraud detection.

Livestock

ARC-Onderstepoort Veterinary Institute (ARC-OVI)

The ARC-OVI (north of Pretoria) is responsible for the prevention and control of animal diseases. It also provides a public-health service regarding food safety and security. The institute conducts research and diagnostic and new-generation vaccine development of livestock diseases.

It has six reference laboratories approved by the *Office International des Epizooties*, namely: rabies, lumpy skin disease, rift valley fever, African horse sickness, African swine fever and bluetongue. The Exotic Diseases Division is a high-containment facility for diseases such as foot-and-mouth disease and African swine fever. The institute is also the Food and Agricultural Organisation collaborating centre in Africa for transboundary diseases.

ARC-Livestock Business Division: Animal Production (ARC-LBD: Animal Production)

ARC-LBD: Animal Production (in Irene, outside Pretoria) comprises seven units, which assist the animal production and products industry to stay

abreast of global competition. Animal Genetics and Biotechnology employs DNA technology, genetic characterisation and accelerated reproduction technology to conserve, maintain and enhance genetic variation. Together with the Animal Recording and Improvement Unit, this has assisted livestock producers in breeding seed-stock material to the benefit of genetic resources worldwide.

Cattle breeds such as the Bonsmara and Nguni, Dorper sheep, boerbok goat, Fowls for Africa, South African ostrich and the indigenous Kolbroek pig have become highly sought after in breeding programmes abroad.

The Production Systems Unit deals with cattle, small stock, pigs and poultry. The Range and Forage Unit assists in the effective use of rangeland and forage production.

Council for Scientific and Industrial Research

Constituted by an Act of Parliament in 1945, the CSIR is one of the leading scientific and technology research, development and implementation organisations in Africa. The CSIR's main site is in Pretoria, while it is represented in most of South Africa's nine provinces through regional offices.

The organisation undertakes directed and multidisciplinary research, technological innovation, and industrial and scientific development to improve South Africans' quality of life.

The CSIR is committed to supporting innovation in South Africa to improve national competitiveness in the global economy. S&T services and solutions are provided in support of various stakeholders, and opportunities are identified where new technologies can be further developed and exploited in the private and public sectors for commercial and social benefit.

The CSIR receives an annual grant from Parliament, through the Department of Science and



The National Science and Technology Forum announced the top achievers and contributors to Science, Engineering and Technology (SET) for 2006 during its awards gala dinner in May 2007.

Ten individuals and three organisations were honoured for their outstanding contributions towards SET development. Winners were selected from 70 nominations. Educators, schools and students who had excelled in Mathematics, Science and Technology, were also acknowledged.

The winner of the Individual over a Lifetime category was Prof. Doug Butterworth.

Technology, which accounts for close to 40% of its total income. The remainder is generated from research contracts with government departments at national, provincial and municipal levels, the private sector and research-funding agencies in South Africa and abroad. Additional income is derived from royalties, licences and dividends from an IP portfolio and commercial companies created by the CSIR.

The parliamentary grant is focused on the knowledge base and facilities in the CSIR to ensure these stay at the leading edge of technological development. It is invested in developing new areas of expertise, undertaking pre-competitive research (too risky for the private sector to fund) and for training young researchers.

The CSIR's shareholder is the South African Parliament, held in proxy by the Minister of Science and Technology. South Africa's national imperatives and global challenges provide the macrostrategic framework within which the CSIR conducts its research. In an effort to contribute to placing the African continent on a path of sustainable growth and development, the organisation supports and actively participates in Nepad.

In line with its mandate, the CSIR contributes to the national programme of development by:

- building and transforming human capital
- strengthening the S&T base
- performing relevant, knowledge-generating research, and transferring technology and skilled human capital.

The CSIR transfers the knowledge generated through research activities by means of technology and skilled people. The generation and application of knowledge reside at the core of the CSIR. This takes place in domains such as biosciences; the built environment; defence, peace, safety and security; material science and manufacturing; and natural resources and the environment.

Emerging research areas (Eras)

The CSIR explores these new science areas, that could be unique to local circumstances or be successful internationally and need to be established for local competitiveness. Examples of Eras include nanotechnology, synthetic biology and mobile autonomous intelligent systems.

National research systems

The CSIR houses specialist facilities of strategic importance for African science. These include ICTs, laser technology and space-related technology.

Research and development outcomes

The R&D Outcomes Portfolio includes IP management, technology transfer (for commercial gain as well as for social good), knowledge dissemination and impact assessment.

Knowledge services

The CSIR Knowledge Services group manages specialised and differentiated services. This is done on a routine basis to address the needs of clients.

Mintek

Mintek, South Africa's national mineral-research organisation, is one of the world's leading technology organisations specialising in mineral processing, extractive metallurgy and related areas. Working closely with industry and other R&D institutions, Mintek provides service testwork, process development, consultation and innovative products to clients worldwide.

Mintek is an autonomous statutory organisation that reports to the Minister of Minerals and Energy. About 30% of the annual budget of R350 million is funded by the State Science Vote, with the balance provided by contract R&D, sales of services and products, technology-licensing agreements and joint-venture operating companies.

Mintek's objectives are to research, develop and transfer to industry, novel and improved technologies to optimise processing, extracting, refining and using minerals and mineral products, to:

- enhance the competitiveness of South Africa's minerals industry in the global market
- assist local mining and engineering companies to expand internationally
- promote job creation, economic growth and regional development.

Specific goals of the organisation include:

- promoting increased beneficiation of South Africa's minerals and mineral commodities by developing competitive and innovative processing technology and equipment
- strengthening South Africa's international



position as a supplier of mineral technologies, capital goods and services

- developing regional strategies for the mineral-processing sector, concentrating on value-addition, capacity-building and broad-based development.

Mintek's activities include:

- providing essential services (information, consulting and experimental)
- increasing the competitiveness of the industry by developing appropriate technology to cut costs and improve and optimise recoveries
- developing breakthrough process technologies and novel uses for metals and their products
- marketing its commercial products and technologies to industry
- establishing strategic partnerships and joint ventures
- participating in regional development initiatives and SADC activities and projects
- maintaining and expanding international scientific links
- developing the HR potential of the region through education and training activities.

Mintek offers a complete range of process-development services, from preliminary bench-scale investigations to large-scale piloting and integrated flowsheet development in support of bankable feasibility studies. Engineering design, plant construction and commissioning are conducted in conjunction with international partners.

Comprehensive laboratory and piloting facilities for sample preparation, milling, flotation, physical separation, smelting, leaching, pressure leaching, and metal recovery and purification, are supported by internationally accredited analytical laboratory and mineralogical services.

Mintek's R&D activities are focused particularly on mineral commodities that are important to the South African economy:

- Gold-improving technologies, such as biotechnology and ion-exchange processes are developed and introduced to simplify processing and increase recoveries, particularly from ores that are difficult to treat. A major joint venture with industry and other research groups is exploring new industrial uses of gold in the fields of catalysis, nanotechnology and biomedicine.
- Platinum-group metals' (PGMs) R&D is aimed at increasing the cost-effectiveness of PGM production and stimulating industrial demand for PGMs.
- Ferrous-metal products and technical services are developed to increase the cost-effectiveness

of ferro-alloy production, as well as stainless steels and other alloys with improved properties.

- Mintek has done a large amount of work for non-ferrous metals, such as new copper, nickel and cobalt, through projects in southern and central Africa. Processes are also developed for aluminium, lead, magnesium and zinc. The major emphasis is on the introduction of cleaner technologies.
- R&D includes the beneficiation and processing of industrial minerals, including commodities such as heavy mineral, chromite, iron and manganese ores, andalusite, phosphates, fluorite and diamonds.
- With the upswing in the uranium market, Mintek has re-established itself as one of the foremost uranium laboratories in the country, and has played a significant role in developing and optimising several new projects on the African continent.

Promoting industrial growth

Mintek is promoting a number of major new industrial projects based on mineral beneficiation, using existing and newly developed technologies. These include the recovery of PGMs from metallurgical waste material, ferro-nickel production, and the establishment of a local magnesium industry using a novel thermal production route.

Minerals policy and development

Mintek conducts surveys, evaluations and commodity and market studies to support initiatives by governmental, international, regional or industry associations. It also identifies and evaluates potential development projects, assesses and provides technology, and conducts feasibility studies.

The organisation co-operates with industry and other research institutions and academia to maintain and enhance the mineral sector's contribution to society, by providing strategic direction and procedures that promote value addition and sustainable development in the mining industry.

Mintek is frequently called upon to support strategy and policy issues at all levels in South Africa, including participation in Nepad and the African Mining Partnership, through research into broad-based economic-development issues around mining and minerals.

Mintek is growing its capacity to lead and support multiple initiatives in small-scale mining and beneficiation, and is well positioned to lead

projects that will benefit economies on the African continent and support government initiatives to create employment in mining, manufacturing and agriculture at local and rural levels.

Environment

Mintek continues to focus on developing environmentally responsible technologies for the recovery and recycling of metals from metallurgical residues. A major programme is in place to monitor cyanide species in various locations around gold plants, from both an environmental and a processing point of view. Mintek's environmental-management system is certified as meeting the requirements of the International Organisation for Standardisation (ISO) 14001.

Education

The development of appropriate HR is crucial for the long-term sustainability of the minerals industry. Mintek's education and training initiatives focus on developing and training South Africans from historically disadvantaged communities as technicians, technologists and engineers. Training programmes include:

- artisanal and small-scale mining training
- jewellery-manufacturing training
- upgrading Mathematics and Science skills
- science promotion through participation in various SET initiatives (sponsored by the departments of science and technology and of minerals and energy), corporate events, university open days, and the Minquiz national schools' science competition
- corporate social investment/responsibility through Mintek's Adopt-a-School Programme and Girl 11 and 12 Learner Programme
- undergraduate and postgraduate bursary schemes
- in-training programmes for recently qualified engineers and technicians
- specialised advanced technical programmes.

Human Sciences Research Council (HSRC)

The HSRC, South Africa's statutory research agency, conducts research that generates critical and independent knowledge, relative to all aspects of human and social development.

Alleviating poverty, and developing and implementing public policy are central to its research activities. Its research extends beyond South African borders, through projects and collaborations in other African countries.

As a social-science research organisation committed to making a difference in the quality of life of ordinary people, the HSRC is often commissioned to undertake large-scale research on behalf of government departments at national, regional and local levels.

The HSRC also serves the research needs of parastatal organisations, the private sector and local and international development agencies, to track service delivery, evaluate performance and measure the efficacy of interventions.

The HSRC's collaborative approach to research provides a platform for interaction with research experts in South Africa, elsewhere in Africa and internationally. In addition to conducting commissioned research, the organisation proactively disseminates its research findings in peer-reviewed and other publications, and through seminars, invited lectures and media briefings.

Functioning as a knowledge hub, the HSRC contributes to bridging the gap that so often exists between research, policy and action.

The research undertaken by the HSRC has been configured into five interdisciplinary research programmes:

- Child, Youth, Family and Social Development
- Democracy and Governance
- Education, Science and Skills Development
- Social Aspects of HIV and AIDS and Health
- Urban, Rural and Economic Development.

Five cross-cutting research units and two priority initiatives have been established to interactively contribute to, and draw from, the five research programmes to integrate and enhance the work of the HSRC as a whole. The units are:

- Capacity Development
- Gender and Development
- Knowledge Systems
- Policy Analysis
- Social Aspects of the Southern African HIV and AIDS Research Alliance (Sahara).

The Policy Analysis Unit has a dual mandate. The first is to serve as a think tank and provide a



platform for public discourse of critical social issues. The second is to pursue time-limited, multiyear analyses into specific priority areas, namely poverty reduction, employment, quality education, HIV and AIDS, and service delivery. The work of the unit is centred around the various crossroads between these policy issues and heuristic parameters, drawn from the NRDS.

The first two priority initiatives are the National Quality Education Initiative and the Employment, Growth and Development Initiative.

Research programmes

Child, Youth, Family and Social Development

The Child, Youth, Family and Social Development Unit aims to promote human and social development through the production of high-quality applied research that addresses challenges arising from social inequality, poverty, violence, HIV and AIDS and other causes of ill-health, suffering and loss of human potential.

The programme researches aspects of the life course, from infancy to old age, with an emphasis on understanding how contexts, policies and politics shape and distribute life chances.

Democracy and Governance

The Democracy and Governance Unit recognises that there is an ongoing need to consolidate South Africa's relatively young democracy, continually improve governance and address emerging issues in fresh and substantive ways. The unit examines issues that contribute to or constrain the growth and development of democracy in South Africa and the rest of Africa, the outcome of which promotes and informs public debate.

Education, Science and Skills Development

The Education, Science and Skills Development Unit plays a critical role in fulfilling the knowledge and skills requirements to keep the country and its people competitive in an increasingly global environment.

The work of the unit spans three major social domains in the form of the education system, the NSI and the world of work. The programme aims to produce comprehensive, integrated and holistic analyses of the pathways of learners through schooling, further and HE, and into the labour market and NSI.

Social Aspects of HIV and AIDS and Health

The Social Aspects of HIV and AIDS and Health Unit undertakes cutting-edge and innovative research

into HIV and AIDS and public health, so as to contribute to public-policy dialogue and formulation, and improve health-service delivery.

It focuses on research that is policy-relevant and responds to the current challenges facing South Africa, while also assessing, monitoring and evaluating HIV and AIDS and health programmes that aim to improve the lives of South Africans.

Its primary focus is on the key socio-cultural, political, economic and demographic determinants that increase or reduce vulnerability to HIV-infection.

It also addresses risky behaviour, prevention and interventions. In the area of health policy, it conducts strategic epidemiological research and demographic analyses into mortality, natality and fertility.

Urban, Rural and Economic Development

The Urban, Rural and Economic Development Unit primarily aims to promote integrated urban and rural development in the country through problem-oriented research, user-driven policy development and ongoing monitoring and evaluation.

With poverty reduction as the unifying theme, the unit's objectives and activities are specifically designed to address key national, regional and Africa-wide underdevelopment challenges and policy priorities through a collaborative approach to research.

Cross-cutting units

Policy Analysis

The Policy Analysis Unit serves as a think tank and forum for the deliberation and analysis of public policy on the most critical issues affecting the lives of people in Africa. It focuses on issues such as poverty reduction, employment, quality education, HIV and AIDS, and service delivery.

The unit conducts systematic evaluation of policies and suggests alternative means of achieving social goals. It also analyses existing or prospective policies with the intention of suggesting alternative ways of improving the population's social welfare.

Capacity Development

The Capacity Development Unit was established to develop individual and institutional research capacity. Using a collaborative approach, the unit intends to increase the pool of competent researchers for human and social sciences in South Africa and support the development of black and female researchers to enable the HSRC to meet its equity targets.

Gender and Development

The unit provides the HSRC with a gender "lens", thereby empowering it to make men's and women's concerns and experiences an integral dimension of the design, implementation, monitoring and evaluation of policies and programmes, to equally benefit both sexes.

Social Aspects of the Southern African HIV and AIDS Research Alliance

Sahara is an Africa-wide network co-ordinated by the HSRC. It has the expressed purpose of sharing research expertise, knowledge and experiences on HIV and AIDS with policy-makers, other researchers, government departments and organisations working in this field.

Through this alliance, Sahara seeks greater understanding of the pandemic in the hope of contributing to a reduction in the number of new HIV infections and, ultimately, to a reversal in the spread of HIV and AIDS.

Knowledge Systems

The Knowledge Systems Unit conducts primary and secondary research on socio-economic and governance issues to facilitate evidence-based decision-making.

The unit works with external research users and supports the research programmes of the HSRC, while also building complementary expertise throughout Africa.

The key focus of the unit involves the design, implementation and analysis of quantitative and qualitative data to enhance the knowledge-management strategies of the HSRC and promote social scientific research and capacity-building throughout South Africa and the African continent.

National priority initiatives

National Education Quality Initiative

The National Education Quality Initiative was established to focus on education quality, with the aim of supporting the Government and other key role-players in enhancing decision-making based on research evidence that could contribute to improving educational quality.

The initiative is dedicated to supporting role-players in general education, such as teachers,

principals, parents, education officials, NGOs and the donor community, by enhancing evidence-based planning pertaining to policy and practice.

The initiative focuses on the primary determinants of education quality, namely the quality of learning and teaching practices.

Employment, Growth and Development Initiative

This initiative has set out to identify clear, evidenced-based scenarios and strategies for unemployment reduction and employment creation, thereby contributing to the strategic imperative of national economic growth that benefits all.

The scenario process, underpinned by policy-orientated research, engages high-level South African decision-makers from government, business and organised labour in an ongoing round-table dialogue. The areas of research include macroeconomic policy, labour markets and social protection, industrial policy, government-employment programmes, and political-economy questions. These link to practical policy decision-making processes.

Medical Research Council

The MRC's mission is to improve the nation's health and quality of life through promoting and conducting relevant and responsible health research. The MRC is an autonomous body but reports to the Department of Health. It receives 60% of its budget from the Department of Science and Technology. Its head office is situated in Cape Town, with provincial offices in Pretoria and Durban.

The MRC's research activities are aligned with the health priorities of the nation, the national S&T imperatives and the health priorities defined by the Department of Health. Activities are grouped into the following national programmes:

National Programme for Research in Molecules to Disease

This programme undertakes research on human and microbial genetics, genomics, bio-informatics, cell and molecular biology, tissue engineering, oesophageal cancer, molecular hepatology, microbiology, and liver and bone disease.

National Programme for Health Systems and Policy Research

The scientists in this programme conduct research on health systems, clinical epidemiology, biostatistics, health policy, the burden of disease and telemedicine.

National Programme for Infection and Immunity Research

The research units in this programme are involved in research into TB, malaria, immunology of infectious diseases, diarrhoeal diseases, inflammation and amoebiasis, genital-ulcer diseases, respiration and meningial pathogens, and South African traditional medicines. It also incorporates the MRC National HIV and AIDS Lead Programme, whose divisions co-ordinate the South African AIDS Vaccine Initiative, various aspects of biomedical research, (including mother-to-child transmission and microbicides), and prevention of transmission through behavioural change.

National Programme for Non-Communicable Disease Research

This programme undertakes research into heart disease (both laboratory, clinical and public-health research), nutritional intervention, diabetes, crime, violence and injury, anxiety and stress disorders, dental issues, medical imaging, chronic diseases of lifestyle and cancer epidemiology.

National Programme for Environment and Development Research

In this entity, research is undertaken into health promotion, health and development, exercise and sports science, occupational and environmental health, alcohol and drug abuse, and technology transfer.



Telemedicine is one example of how information technology can be used to provide and support healthcare, especially in rural clinics without doctors or specialist advice. Through the use of telemedicine, patients get quicker and better diagnosis and have access to specialised care closer to their homes, thereby avoiding time off work and travel costs.

The Department of Science and Technology supports the Primary Healthcare Telemedicine Workstation project in Grabouw, Western Cape. This clinic is directly linked to the University of Stellenbosch and allows for consultation and diagnosis in various specialities.

The next step in the implementation plan will be the installation of 10 telemedicine workstations in KwaZulu-Natal over the next two years.

National Programme for Women and Child Health Research

This programme undertakes research into many aspects of women's health, including high blood pressure during pregnancy, healthcare strategies in maternal and infant health, perinatal mortality, gender and health, mineral metabolism and nutritional intervention.

South African National Health Knowledge Network

The South African National Health Knowledge Network was established in 1999 at the MRC with funding from the Government's IF.

The network operates under the trade name SA HealthInfo and is available on the Internet at www.sahealthinfo.org. It provides a one-stop interactive forum or resource for quality-controlled and evidence-based health-research information.

Council for Geoscience (CGS)

The main functions of the CGS are:

- documenting the surface of the Earth within the borders of South Africa; compiling geological, geophysical, geochemical and other geoscientific information; and publishing this information in the form of maps and documents
- conducting geoscientific research into rocks, minerals, ores, fossils, etc. in South Africa and publishing research results in national and international journals
- collecting and conserving all geoscientific information and data on South Africa in national collections and electronic databases
- supplying geoscientific services and advice to the national and provincial governments and ensuring informed decisions regarding the optimal and efficient use of the Earth's surface.

The objectives of the CGS are to:

- minimise the geological and geoscientific investment risk for national and international entrepreneurs in the South African mining sector (the quality of available geological information – known as the “geological risk grading” – contributes to about 61% of the investment risk in any country)
- supply the country with basic geoscience data to establish a safe, cost-effective physical infrastructure
- supply basic knowledge to ensure safe, cost-effective and environmentally acceptable urbanisation and housing development
- carry out research into raw materials needed to clothe, transport, feed and provide shelter for the nation.

To accomplish these functions and objectives, the CGS maintains a specialised workforce, consisting of Earth scientists supplemented by technical, support and administrative staff at its headquarters in Pretoria, and at branch offices in the Western Cape, Northern Cape, Limpopo, KwaZulu-Natal and the Eastern Cape.

The CGS maintains the following national institutions:

- The National Geoscience Library in Pretoria is probably the most comprehensive geoscience library in Africa. It includes the Map Library, which contains a collection of South African and African geoscience maps.
- The National Core Library contains a representative stratigraphic-borehole core collection, representing most of the lithological units located within the borders of South Africa. This collection is housed at Donkerhoek, east of Pretoria.
- The Geoscience Museum, in the Transvaal Museum in Pretoria, exhibits rocks and minerals, catering for the Earth-science education of the public, especially schoolchildren.

An extensive laboratory at the CGS head office uses various specialised techniques to analyse rock and soil samples.

Geoscience information and services provided by the CGS are particularly important for the sustainable development of the country. In South Africa's arid regions, the management of groundwater resources (both the quantity and quality thereof) is aimed at providing enough clean water to communities. In addition, the CGS has established the Environmental Geoscience Unit to provide services in this highly competitive and very important field.

Although South Africa is situated on a relatively stable part of the Earth's crust, the CGS maintains a seismic network for recording such events within the national borders and coastal waters off South Africa's coastline. This information is available to interested parties and helps mitigate the problems associated with mining-related seismic events.

The CGS is a world leader in the domain of geophysical surveys, using a detection system deployed on light aircraft. This significantly reduces the cost of very high-resolution geophysical data for mineral exploration. A larger aircraft (a Cessna

Caravan 208B) and a helicopter, can carry larger sensors, dramatically increasing the CGS' capability to conduct high-resolution geophysical surveys.

The CGS leads an initiative by the Department of Minerals and Energy to assist upcoming mining entrepreneurs, particularly those from historically disadvantaged groups, to exploit South Africa's mineral resources in a cost-effective and environmentally friendly way.

Because the CGS plays a leading role in the SADC, several geoscience publications covering the region have been produced, describing heavy mineral sand, diamond, gold, copper and cobalt, bauxite and dimension-stone deposits in the region. A seismic hazard map of the region, a lithostratigraphic table comparing the geological formations in the region, and maps of the Kalahari Basin have also been produced.

In addition to its national responsibilities, the CGS is also active internationally, mainly in Africa. Geological and metallogenic maps of, among other countries, Angola, the Democratic Republic of Congo, Mozambique, Gabon and Morocco, have been produced. By early 2007, major geological mapping projects in Ghana, Mozambique, Madagascar and New Guinea, and the supervision of mapping projects in Mauritania, Mozambique and Madagascar, were under way.

South African Bureau of Standards (SABS)

The SABS was established in 1948 to develop, maintain and disseminate standards in South Africa. Although this core objective has remained unchanged over the years, the mission of the SABS has changed its focus in step with the times. The SABS sees its mission as "improving the quality of life of all South Africans, through the process of standardisation".

Standards South Africa (StanSA)

StanSA is the SABS' core function and is responsible for developing, maintaining and disseminating the country's national standards.

Through its Standards Sales Division in Pretoria, and its offices in Durban, Cape Town and Port Elizabeth, all national standards and those of the International Electrotechnical Commission, the ISO and a host of other foreign standards are made available to the public.

Regulatory Affairs and Consumer Protection

This division of the SABS is responsible for administering certain national regulations, mainly on behalf of the Department of Trade and Industry.

Legal Metrology forms a part of the division and ensures the protection of consumers against incorrect metrological practices, such as the sale of underweight or undersized products.

A specific function, directed towards providing conformity-assessment services to the SMME sector, and other presidential imperatives and social-responsibility activities, are also located in this division.

South African Bureau of Standards Holdings (Pty) Limited

All the conformity-assessment services of the SABS are located in this company. These include testing products, providing system and product-certification schemes, inspecting consignments and training people in these matters. SABS Holdings is a separate company that competes in the private sector and charges for the services that it renders. This is unlike SABS Regulatory Affairs and StanSA, which recover their costs from monies allocated for those purposes under the Science Budget Vote of the Department of Science and Technology. A corporate function provides overhead services, such as finance, HR, legal, marketing and communication, risk management and IT.

Other scientific and research organisations and structures Biotechnology Partnership for Africa's Development

Biopad is a biotechnology regional innovation centre established by the Department of Science and Technology. The centre, initiated in 2002, aims to boost biotechnology development in the region. The core objective is to implement South Africa's NBS.

By the end of 2006, Biopad's investments in research projects and private companies were approaching R200 million. During 2007, Biopad continued to identify near-commercialisation opportunities, particularly in the areas of animal health and production.

Sasol

Sasol Technology conducts most of its fuel- and chemical-related R&D at Sasolburg in the Free State. It also maintains R&D programmes at external CoEs, including St Andrews University in Scotland, Twente University in the Netherlands and the University of Cape Town in South Africa. Sasol

Polymers operates a polymer technology centre near Johannesburg, and Sasol Nitro and Sasol Wax maintain R&D programmes in South Africa and Germany, respectively.

Eskom

Eskom's Technology Services International group is a multidisciplinary industrial laboratory and consulting organisation. It undertakes testing, investigation studies, project management, engineering services and applied research for Eskom and other customers.

ArcelorMittal

ArcelorMittal is the world's number one steel company, with 320 000 employees in more than 60 countries. It has led the consolidation of the world steel industry and today ranks as a truly global steelmaker with an industrial presence in 27 countries. ArcelorMittal is the leader in all major global markets, including automotive, construction, household appliances and packaging. The group is a leader in R&D and technology, holds sizeable captive supplies of raw materials, and operates extensive distribution networks.

National Health Laboratory Service (NHLS)

The NHLS is a national network of integrated pathology laboratories countrywide that use common laboratory-management systems and transport networks to facilitate the transport of specimens, referral of tests to reference laboratories and the delivery of results.

The NHLS includes about 250 laboratories, employing 3 500 people. Their activities comprise diagnostic laboratory services, research, teaching and training, and the production of sera for anti-snake venom and reagents. Laboratories provide diagnostic services to the Department of Health, provincial hospitals, local governments and medical practitioners.

Research conducted by the NHLS covers a wide spectrum of activities in all pathology disciplines. Grants in support of research are made by the MRC, the Cancer Association of South Africa, the South African Sugar Association, the Poliomyelitis Research Foundation, pharmaceutical companies, private donors and numerous overseas institutions. The NHLS finances a large part of the research programme from the earnings of its laboratory services.

The NHLS teaching programme includes training medical technologists in association with universities of technology. University teaching at

both undergraduate and postgraduate level is done through the pathology departments of universities' medical schools.

Bureau for Economic Research (BER)

The BER at the University of Stellenbosch, Western Cape, is an independent and objective economic research organisation. It renders a service to organisations ranging from small one-person businesses to policy-makers at the highest level of government.

National Institute for Tropical Diseases

The National Institute for Tropical Diseases in Tzaneen, Limpopo, is responsible for the ongoing assessment of malaria-control programmes carried out by various authorities in South Africa.

Control methods are assessed and recommendations made to the appropriate authorities regarding equipment, insecticide usage and application. A malaria-reference service is also provided. Malaria tests are carried out by the institute, and statistical analysis of data pertaining to the programme is undertaken.

General research areas

Mine-safety research

The activities of the Safety in Mines Research Advisory Committee are aimed at advancing the safety of workers employed in South African mines. The committee is a statutory tripartite sub-committee of the Mine Health and Safety Council. It has a permanent research-management office managing the rock engineering, engineering and mine occupational health fields of research.

Energy research

The Chief Directorate: Energy of the Department of Minerals and Energy manages a policy-directed research programme. This includes transport energy, renewable energy, energy for developing areas, coal, electricity, energy efficiency, energy economy, and integrated energy-policy formulation.

Agricultural research

Agricultural research is conducted by the ARC, several universities and various private-sector organisations. Provinces are responsible for farm

management and technological development. These activities are aimed at improving managerial efficiency on farms.

The Directorate: Scientific Research and Development in the Department of Agriculture, co-ordinates all agricultural R&D activities.

The National Agricultural Research Forum (NARF) co-ordinates agricultural R&D within the national agricultural research system. The NARF also provides a platform for stakeholder consultations on R&D matters.

Biannual meetings are held to debate and agree on research needs, programmes and budgeting. Efforts are made to ensure that the bulk of research serves the needs of small-scale producers.

Research initiatives have been integrated into the various industries in line with the overall objectives of each agricultural sector.

Water research

Water research in South Africa is co-ordinated and funded by the Water Research Commission (WRC) in Pretoria, Gauteng.

The WRC was established in 1971 through the Water Research Act, 1971 (Act 34 of 1971), following a period of water shortage.

The WRC provides leadership for R&D through the support of knowledge creation, transfer and application. It engages stakeholders and partners in solving critical water-related problems. It is a networking organisation, linking the nation and working through partnerships.

Being a water-stressed country, South Africa progressively needs to find innovative ways of managing water resources to ensure that the basic needs of its citizens are met, that social and economic development is not restricted through poor quality or a lack of water, and that sustainability of water resources and water-dependent ecosystems is achieved.

The WRC continues to play a leading role in building a sustainable water-related knowledge base in South Africa by:

- investing in water R&D
- building sustainable and appropriate capacity
- developing skills for the water sector
- being adept at forming strategic partnerships to achieve objectives more effectively while

making optimal use of the latest available global information and knowledge and other technologies. The Water Research Act, 1971 established the Water Research Fund, which derives income primarily from levies on water consumption.

In supporting the creation, dissemination and application of knowledge, the WRC focuses on five key strategic areas:

- water-resource management
- water-linked ecosystems
- water use and waste management
- water use in agriculture
- water-centred knowledge.

The WRC also calls for specific mechanisms to address key strategic issues of national importance. These issues are dealt with in four cross-cutting domains:

- water and society
- water and the economy
- water and the environment
- water and health.

The organisations most active in water research are:

- universities and universities of technology
- professional consultants
- science councils
- water and waste utilities
- NGOs.

The main areas of research are surface hydrology, groundwater, hydrometeorology, agricultural water use, water pollution, municipal effluents, industrial water and effluents, drinking water, membrane technology, water ecosystems, hydraulics, mine-water management, water policy, developing communities, and the transfer of technology.

The Division: Water, Environment and Forestry Technology (Environmentek) of the CSIR specialises in research into water quality, including technology to meet effluent and water-quality standards, and to establish reclaimed water as an additional water source.

Environmentek is a world leader in research into activated sludge processes and the biological monitoring of water to detect potentially toxic substances. It is also involved in research into the effects of afforestation and veld management on the quantity and quality of catchment water-yield.

Environmental research

The Chief Directorate: Environmental Management of the Department of Environmental Affairs and Tourism annually finances several research and monitoring programmes.

The programmes comprise subjects such as waste management and pollution, nature

conservation, river management, coastline and marine environment, and the atmosphere.

Some programmes are conducted in collaboration with the NRF, while others are undertaken on behalf of the department by the CSIR and universities. Research into human-environment interaction, sponsored by the department, is co-ordinated by the HSRC.

In addition, institutes of the ARC are concerned with environmental research insofar as environmental problems impact on agriculture or are caused by agricultural practices.

The South African Weather Service (SAWS) is a statutory body functioning under the Department of Environmental Affairs and Tourism.

SAWS delivers public-good services, mainly for the protection of life and property, as well as commercial services to the private sector, as stipulated in the Weather Service Act, 2001 (Act 8 of 2001).

The implementation of NiNjo, the new forecasting workstation, will be a major step towards improving the quality of forecasting products and services. SAWS will be the first national meteorological service in the southern hemisphere to have access to this state-of-the-art technology, which presents product development and research opportunities for South Africa's forecasters and researchers.

Among other activities, SAWS runs the Global Atmospheric Watch Programme, which measures and monitors greenhouse gas datasets. The SAWS has also rolled out a number of ozone-monitoring stations in the SADC region.

The NRF directs the multidisciplinary Conservation and Management of Ecosystems and



A new research base worth R200 million is being built to replace the existing one on Marion Island. The building is expected to be ready for occupation by May 2008.

The building will accommodate 80 people and include laboratories, office space, a jacuzzi, an operation centre, two helicopter decks, a technical centre with a workshop, gymnasium, storage space, conference room and medical centre.

The research base on Marion Island is the home of a team of researchers that focuses on the unique wildlife on the island. The researchers also gather important weather data. The South African National Antarctic Programme is responsible for the logistics and scientific support to the Marion and Gough islands and Antarctica South African base stations. Expedition members spent between 13 and 15 months on the islands.

Biodiversity Focus Area, primarily in collaboration with universities and museums, to promote and support research into living resources and terrestrial, freshwater, marine, coastal and atmospheric ecosystems.

Some 170 projects are approved annually, and global issues such as climate change and biological diversity are also included. The sustainable use of natural resources is a priority area, resulting in an increase in projects relying on sociology and the humanities. The NRF also supports a range of environmental research network organisations, such as the Arid Zone Ecology Forum, the Fynbos Forum, the Indigenous Plant-Use Forum and the Savanna Ecology Forum.

Fisheries research

Research into South Africa's fish resources, and their conservation and judicious exploitation, is carried out by research personnel of the Chief Directorate: Marine and Coastal Management, a division of the Department of Environmental Affairs and Tourism, and by several universities and NGOs.

Research is designed to provide parameters for estimates of stock sizes and sustainable yields for the different fisheries.

Coastal and marine research

The Chief Directorate: Marine and Coastal Management advises on the use of marine living resources and the conservation of marine ecosystems, by conducting and supporting relevant multidisciplinary scientific research and by monitoring the marine environment.

Sustainable use and the need to preserve future options in using marine ecosystems and their resources are guiding objectives in the research and advice provided by the chief directorate.

The NRF supports marine and coastal research in partnership with the Department of Environmental Affairs and Tourism, and the South African Network for Coastal and Oceanic Research.

Private-sector involvement

South Africa's gold-mining industry works at deeper levels and under more difficult conditions than any other mining industry in the world. The research into gold mining conducted by the CSIR's

Mining Technology group, is concerned primarily with ensuring the health and safety of the workforce. It includes those working in the areas of rock engineering and the underground environment.

Mining Technology's coal-mining research takes place on a smaller scale than that of gold mining, because the coal-mining industry can make use of various overseas developments.

Areas in which research is undertaken include strata control, mining, maximising the extraction of coal, and the underground environment.

Research is also carried out by a large number of industrial companies with facilities to meet their specific needs.

The more important ones are the:

- Anglo American Corporation of South Africa (applied metallurgy, processing of precious metals, base metals and coal)
- Agricura (synthesis and testing of veterinary remedies, insecticides, herbicides and entomology)
- Cullinan Holdings (refractories and electrical porcelain)
- De Beers Industrial Diamond Division (manufacturing and application of synthetic diamonds and other super-hard material)
- Johannesburg Consolidated Investment Company (metallurgy, mineralogy, chemistry and chemical engineering)
- National Chemical Products (chemistry, microbiology and animal nutrition)
- Metal Box Company of South Africa (corrosion mechanism and microbiology)



The National Accessibility Portal Project at the Meraka Institute addresses the marginalisation of people with disabilities through information and communications technology.

Many of the researchers are people who have disabilities themselves. They have developed a portable information and communications device for visually impaired people that has built-in speech technologies and access to the Internet and audio books.

They have also designed a highly customised picture-based tool that provides an alternative communication mechanism to people with physical disabilities and to those who cannot talk. Twenty-seven specially equipped centres will be established over the next two years.

- 
- Tellumat (development of electronic instruments)
 - Rembrandt Group (development and improvement of tobacco and liquor products)
 - South African Pulp and Paper Industries (wood

- technology, paper manufacturing and water treatment),
- Standard Telephones and Cables SA (long-distance transmission of information and lightning protection).

Acknowledgements

BuaNews

Council for Geoscience

Estimates of National Expenditure 2007, published by National Treasury

Human Sciences Research Council

Medical Research Council

Mintek

National Health Laboratory Service

National Research Foundation

South African Bureau of Standards

Water Research Commission

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Suggested reading

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